eight persons, and no doubt would be with a larger number. The hands should be moistened.

These experiments show in a simple and striking way that in the telephone we have an instrument which is sensitive to very minute electric impulses. W. CARPMAEL

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ELIAS MAGNUS FRIES

By the death of Fries, Sweden has lost one more of the line of eminent botanists whose labours have thrown a lustre so great upon Scandinavian science. Well versed in all domains of phanerogamic botany, and especially skilled in his native plants, it was amongst the cryptogams he spent the more active years of his long life. While lichenology owes to him valuable illustrations, fungology received at his hands a large element of its construction. In the acquisition, description, and systematic arrangement of the larger fungi he exhibited a zeal, a tact, and a perspicuity which seem to have left comparatively little to be done in later times, either by way of addition or improvement.

Elias Magnus Fries was born in Småland on August 15, 1794. His father, pastor of the church at Femsjö, was an ardent and accomplished botanist. As there were no boys of his own age whom the young Fries could make companions, he constantly accompanied his father in his walks, and was in his earliest years made intimate with all the flowering plants of a district diversified by forest, mountain, marsh, and river. About the age of twelve he lighted upon an especially brilliant Hydnum, and was then first incited to the study of the Agarics and their allies, that abound in his native land more than in any other region of Europe. Before he left his school at Wexio he knew, and had given temporary names to, nearly 400 species. In 1811 he entered the University of Lund, where he had Schwartz, Agardh, and Rezius as his teachers; and in 1814 was chosen Docent of Botany. In this year he published his "Novitiæ Floræ Suecicæ," first part, the second part following in 1823. In 1815 appeared his "Observationes Mycologicæ," the first important result of his fungological researches. In the following year, dissatisfied with the method of Persoon, he began to construct an entirely new system. As a first fruit he wrote his "Specimen Systematis Mycologicæ," a tract of a few pages, and, in outline, his great work the "Systema Mycologicum," the first volume of which appeared in 1821 and the last in 1829. In 1825 he sent forth the "Systema Orbis Vegetabilis," first part, a work not further completed, and in 1828 the "Elenchus Fungorum," a commentary on the Systema. In 1831 was published "Lichenographia Europæa Reformata," and in 1838 his second great work, the "Epricisis Systematis Mycologici." About this time he completed the manuscript of a "Synopsis Ascomycetum," in which he had included upwards of 600 new species. Owing to his impatience of the critiques of Corda, Kunze, and the German fungologists who had begun to avail themselves of the new aid of the perfected microscope, an assistance which Fries denied himself, he refrained from publishing it, but one may hope this valuable MS. may still exist. In 1834 he was made Professor of Practical Economy at Upsala, from which place he gave out the "Flora Scanica." He was sent to the Rigsdag in 1844 and 1848 as representative of his university, and was made a member of the Swedish Royal Academy in 1847 In 1851 he succeeded to the chair of Botany at Upsal, vacated by Wahlenberg, which he resigned only a few years before his death to his son. In 1846 he published the "Summa Vegetabilium Scandinaviæ," and in 1860, "Sveriges ätliga och giftiga Svampar," with fine coloured plates. A project of the Royal Society of Holm to publish at its expense drawings of all species of Hymenomycetes under Fries's direction, induced him to write a third and fuller description of the Agarics, of which he printed only 100 copies, under the title of "Monographia Hymenomycetum Suecicæ," in 1863. The first fasciculus, however, of the corresponding "Icones," appeared only in 1867; a second volume was commenced towards the end of last year. Fries lived at Upsal all the latter years of his life, in good health, and in constant correspondence with the botanists of this and other countries, taking, so far as his age permitted, all his early interest in his favourite Agarics. Thus he published, in 1874, a second edition of his "Epicrisis," including in it all the later found European species.

He died, after a short illness, on the 8th inst.

THE TELEPHONE, AN INSTRUMENT OF PRECISION

The applications to which the telephone may in future be put cannot yet be all foreseen. I have to-day had its value shown to me in a remarkable way. 1. I used a thermo-electric intermittent current by drawing a hot end of copper wire along a rasp completing the circuit. A telephone was put into the circuit, in another room, and every time that the wire was drawn along the rasp a hoarse croaking was heard in the telephone. 2. I used a thermopile with a Bunsen burner shining on it from a distance of six feet. The current was rendered intermittent by the file, and the sound was most distinctly heard. A Thomson's reflecting galvanometer was introduced into the circuit which showed that the currents were extremely small. 3. The feeblest attainable currents were now tried. The thermopile was removed, and without any artificial application of heat it was shown by the galvanometer that the natural differences in the temperatures of the different junctions in the circuit were sufficient to generate feeble electric currents only just perceptible with the mirror galvanometer. These were easily detected by aid of the rasp and the telephone. Even when contact was simply made and broken with the hand, a click was heard in the telephone. 4. Lastly, these feeble currents were rendered still more insignificant by passing them through the body of a friend who held one end of the wire in each hand, and still the effects were faintly audible. Here the galvanometer, which was still in circuit, hardly gave any indication.

I have now added the telephone to the list of apparatus in the laboratory, considering it to be perhaps the most delicate test of an electric current which we possess.

In these experiments only one telephone is used, viz., at the receiving end. Employed in this way with a powerful current sent from the other end of the line, we may hope to have messages sent through submarine cables much more rapidly than at present. Probably it will be best to have the intermittent nature of the current maintained by an induction-coil, or by a spring rubbing against a continuously rotating cog-wheel, when the current is allowed to pass only when required by the depression of a key which communicates to the listener at the receiving end the long and short dashes of the Morse alphabet.

I ought to mention that I believe the person who first used a thermo-electric current with a telephone was Prof. Tait. GEORGE FORBES

Andersonian College, Glasgow, February 13

OUR ASTRONOMICAL COLUMN

LOHRMANN'S LUNAR CHARTS.—At last astronomers are put in possession of the charts of the moon's surface, commenced by W. G. Lohrmann, of Dresden, in 1821. They are now completed in twenty-five sections; but previously only one part, containing four topographical sections, had been published. This was issued at Leipsic in 1824; a small general chart was lithographed at Dresden at a later period. It is through the active

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interference of Prof. Julius Schmidt, the Director of the Observatory at Athens, whose elaborate lunar work is well known, that the complete publication of Lohrmann's charts has been effected. A pretty detailed prospectus has been circulated. The price of the entire work will be 2*l.* 10*s.*

THE PERIODICAL COMET, 1873 II.—The interesting comet of short period discovered by Tempel on July 3, 1873, was, it is understood, taken in hand by one of the able astronomers attached to the Observatory of Vienna, in which case an ephemeris may soon be expected. The last calculation of elements assigned a period of revolution of only 1,850 days, and it is possible that observations in November, 1873, may have indicated a still shorter period, so that the comet may again arrive at perihelion very early in the summer. Four days after the perihelion passage this comet makes a very near approach to the orbit of Mars, but the recent discovery of satellites to this planet detracts from the importance which would otherwise have attached to a study of the comet's motion, in the hope of eventually improving our knowledge of the planet's mass.

MINOR PLANETS.—Of all the members of this group the elements of which have been calculated, No. 153, *Hilda*, discovered by Palisa at Pola on November 2, 1875, makes by far the nearest approach to the orbit of Jupiter, and on this account it is desirable the planet should be kept under observation at successive oppositions. So far, it does not appear to have been recognised during the present one, though an ephemeris extending to February 20, was given in number 84 of the *Berlin Circular;* this will have been owing, no doubt, to its situation in a part of the sky for which we have no charts showing very small stars. According to the estimation made by Palisa on the night of discovery when the planet's distance from the earth was 3·22, and from the sun 4·20, its brightness at present will be equal to that of a star of the thirteenth magnitude. Subjoined is a continuation of the ephemeris deduced from the best orbit yet available, that by Kühnert, which is founded on observations from November 2 to December 30, 1875 :—

HILDA : AT GREENWICH MIDNIGHT.

		R.A. h. m. s.	N.P.D. ° ′	Dist. from Earth.
February	28	7 57 36	78 49·2	3·723
March	2	7 56 57	78 44·5	3·760
,,	4	7 56 21	78 39·9	3·780
,,	6	7 55 48	78 35·3	3·801
,,	8	7 55 18	78 30·8	3·823
,,	10	7 54 52	78 26·5	3·845
,,	12	7 54 30	78 22·3	3·868
,,	14	7 54 12	78 18·1	3·893

Mr. W. Godward, of the *Nautical Almanac* Office, availing himself of the observations of Ceres which have been made at the Royal Observatory, Greenwich, at every opposition between 1857 and 1876, has corrected the elements of this, the first discovered of the small planets, and has succeeded in representing its course during the interval of about twenty years, with a precision which we do not remember to have seen attained in any previous investigation of the like nature. The residual errors in R.A. and declination in no case amount to five seconds of arc. Applying the corrections given by Mr. Godward in the *Monthly Notices* of the Royal Astronomical Society for January last, there result the following doubtless very exact elements of Piazzi's planet for 1878 :—

Epoch, 1878, November 16·0 G.M.T.

	° ′ ″	
Mean longitude	47 50 24·5	
Longitude of perihelion	149 40 57·1	From M. Eq. of Epoch.
,, ascending node	80 47 43·1	
Inclination	10 37 17·9	
Angle of eccentricity	4 30 57·2	
Mean daily motion	771″·31117	

From the *Berlin Circular* No. 85, it appears that with the exception of the small planet observed by Prof. Peters on February 6, which proves to be *Antigone*, the planets lately observed are new. Their numbers and discoverers, with dates of discovery and magnitudes, are :—

No. 180	Perrotin	Jan. 29	12·0m.
No. 181	Cottenot	Feb. 2	10·0m.
No. 182	Palisa	Feb. 7	10·5m.
No. 183	Palisa	Feb. 8	12·0m.

As we anticipated, No. 180 proves to be distinct from *Urda*, which remains to be recovered.

BIOLOGICAL NOTES

THE ORIGIN OF THE CARBON OF PLANTS.—Mr. J. W. Moll has made in Prof. Sach's laboratory at Würzburg, some researches on this subject during the summer of 1876. A detailed account of these, with the conclusions at which he has arrived, is promised in the *Landwirthschaftliche Jahrbücher von Nathusius und Thiel*, but a brief account will be found in the last number of the *Archives Néerlandaises*, tome xii., 4me livre. A plant with green-coloured cells can, under the influence of light, take the carbon it requires from the atmosphere, releasing in the act of doing so, so much oxygen. This is a fact, too well vouched for by the experiments of Boussingault, Vogel, Rauwenhoff, and Harting, to admit of a doubt, but the quantity of carbon dioxide in our atmosphere is very small, and the quantity of carbon stored up during say a summer's growth in some large forest, is very great. Moreover, the roots of such plants are fixed in a soil which is highly charged with carbonaceous products, so the question quite naturally arises, may not the roots take up some of these atoms of carbon ready to their hand ? or may they not at least take up the carbon in the form of carbon dioxide, send this up the green granules in the leaves, and so give them a more abundant supply than they could get from the surrounding air ? Besides, is it not a fact that most plants seem to thrive in a fine rich leaf mould, and may not its richness in carbon be partly the cause ? One of the first questions Mr. Moll set himself to answer was—Can leaves decompose carbon dioxide which is furnished to the root of the stem from which the leaves spring ? Now, starting with assent to Prof. Sach's discovery that the starch of the chlorophyll granule is the first visible product of the fixation of some carbon atoms, there was here a ready method of proving whether this were so or not. In the course of several experiments it was contrived that leaves destitute of these starch granules should be in an atmosphere deprived of carbon dioxide, while at the same time they were well exposed to the influence of light. The roots were fixed in moist soil well supplied with carbon dioxide, and the result was that under these circumstances no starch granules were formed ; and in a modification of this experiment, where one portion of a leaf was allowed to be exposed to ordinary air, that portion at once set to forming its starch. Botanists no doubt will welcome the publication of the experiments of which we have now only the brief result ; doubtless more research will end in more discoveries in this most interesting field, for how can one account for the fact that some plants do, as we might say, fatten by feeding on carbon atoms, although these very plants cannot take these atoms when in union with oxygen ?

FERNS AND MOSSES.—Hofmeister's work on the "Higher Flowering Plants (Cryptogamia)" is truly indispensable to every scientific botanist, and, thanks to Mr. Curry, the English student has it at his command. It commences with an account of a not uncommon little plant called *Anthoceros lævis*, and it finishes with an account of those cryptogams very high in rank and vast in size, known to us as cone-bearers, and of which the churchyard yew or the giant Wellingtonia may serve as

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